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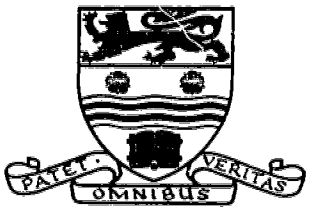
ABSTRACT

Recent policy on the training of primary school teachers has brought into focus the question of teachers' subject matter knowledge and its value and influence on classroom practice. With a sample of 8 students, this study collected data on four aspects of their practice with the aim of exploring the processes by which subject matter knowledge might inform professional action. Data included the beliefs and predispositions of student teachers about teaching, lesson planning protocols, stimulated recall protocols, and students' assessments of pupils. A qualitative analysis of this data suggests that subject matter enters student teachers' thinking about practice mostly via their classroom observations and their discussions with experienced teachers. Different schools and supervising teachers offered different opportunities for students to engage in such activities and afforded varying classroom conditions in which their subject matter knowledge could be related to pupil experiences and difficulties. Such findings, if typical, raise issues about how we conceptualize and research teachers' professional knowledge and also have practical implications for the organization of school experiences in teacher training. (Author)



Number one

The Integration of Subject Matter Knowledge in Student Teachers' Classroom Practice

by
JAMES CALDERHEAD and EDDIE MILLER

Series Editor: DAVID McNAMARA

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RESEARCH MONOGRAPH SERIES

Paper 1: The Integration of Subject Matter Knowledge in Student Teachers' Classroom Practice.
[J. Calderhead and E. Miller, October 1986]

October, 1986

James Calderhead – ta ght in both primary and secondary schools before joining the Department of Educational Research at Lancaster University in 1979. His research interests lie in teachers' professional learning and he has written widely on teachers' thinking and decision-making, including *Teachers' Classroom Decision-Making* and the forthcoming collection of papers, *Exploring Teachers' Thinking*, both published by Holt, Rinehart and Winston.

Eddie Miller – after teaching in several schools moved into teacher education in 1967. Between 1980 and 1985, he was Director of Studies for the PGCE at Sheffield City Polytechnic, where he is currently Director of Studies for the B.Ed. degree programme. His interests lie in the design of teachers' professional studies courses.

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EDITORIAL

The University of Lancaster's School of Education is keen to foster and disseminate research in the field of teacher education and training. The established, specialist journals provide the publishing outlet for the shorter report but there is a need to offer a means by which scholars can make available to the relatively specialist teacher educator audience more substantial research reports. Thus the School of Education has decided to establish a *Research Monograph Series* which will provide a medium through which educationists with an interest in teacher education can publish research which will be of interest to teacher educators.

The first monograph in the series is by James Calderhead and Eddie Miller and it investigates the way in which student teachers' subject knowledge influences their professional and pedagogic practices. In this case a distinctive advantage of the monograph format is that it provides the space for the detailed reporting of the qualitative data generated by the research. Hence student teachers' classroom practice can be examined in the context of the "real time" constraints within which class teachers must operate. We would, therefore, hope that the report provides pertinent information which will be of value and relevance to teacher educators, especially those responsible for students' school based experience.

David McNamara
Series Editor
October 1986

t policy on the training of primary school teachers has e question of teachers' subject matter knowledge and its classroom practice. With a sample of 8 students, this study r aspects of their practice with the aim of exploring the bject matter knowledge might inform professional action. iefs and predispositions of student teachers about teaching, gpr ocols, stimulated recall protocols, and students' assessments ive analysis of this data suggests that subject matter enters nking about practice mostly via their classroom observations as with experienced teachers. Different schools and supervis- red different opportunities for students to engage in such orded varying classroom conditions in which their subject matter ld be related to pupil experiences and difficulties. Such findings, if issues about how we conceptualise and research teachers' profes- vledge and also have practical implications for the organisation of eriences in teacher training.

Subject Matter Knowledge in Primary Teaching

Recent policy recommendations concerning the training of primary school teachers have emphasised the importance of teachers' subject matter knowledge (HMI 1982, DES 1983, DES 1984). In particular it has been stated that at least 2 years' post A-level study of a subject related to the primary school curriculum be an essential part of B.Ed. courses, and that one of the criteria for selection for PGCE courses be a curriculum relevant degree.

Such recommendations have generated considerable debate amongst teachers and teacher trainers, some of whom have questioned the applicability of university studies to the classroom situation and have emphasised the importance of other areas of competence, such as managerial and social skills. Others have argued that intending primary school teachers' subject matter knowledge ought to be more general in nature and not necessarily at a high level. Others still have claimed that its value lies in the experience of learning as an adult, with its associated skills and affective responses, rather than in the acquisition of knowledge itself.

Much of this debate is founded upon protagonists' personal experience, educational values and preferences, and there is little empirical evidence or theoretical understanding of the nature and functioning of subject matter knowledge in teaching. What subject matter knowledge do teachers have? How is it acquired? How does it inform their practice of teaching? What subject matter knowledge does the task of primary teaching demand? Whilst several studies have investigated the professional socialisation of teachers (e.g. Hanson and Herrington 1976, Lacey 1977, Mardle and Walker 1980, Zeichner and Tabachnick 1985) informing us of the experiences of student teachers and offering general models for conceptualising the transition from student teacher to teacher, little attention has been directed specifically to the knowledge bases of teachers or to the role of subject matter knowledge in particular.

* *This monograph is based on a paper presented at the British Educational Research Association Annual Conference, University of Sheffield, September 1985.*

Elbaz (1983) in a case study of one secondary English teacher, suggests that teachers' subject matter knowledge may be associated with certain ideological commitments which influence how teachers think about their work and organise their practice. Elbaz's teacher, in fact, appeared to hold different conceptions of English as subject matter (e.g. as a set of skills or as a process of aesthetic appreciation) at different times and in different contexts and these became modified in interaction with the dominant ideology of the school and with personal experience. Elbaz's study highlights some of the complex relationships amongst subject matter knowledge, alternative professional values and other areas of teachers' practical knowledge and the context in which it is used.

In contrast, Leinhardt and Smith (1985) adopt Anderson's (1983) model of human cognition, distinguishing teachers' procedural knowledge and subject matter knowledge, and attempt to map out these knowledge bases into detailed semantic networks using interviews and stimulated recall procedures on a series of classroom mathematics lessons. Adopting this approach, the researchers found that although their sample of eight teachers generally possessed adequate procedural knowledge to organise and present lessons, their knowledge of mathematics was frequently patchy or inaccurate and led to teaching situations which were confusing to pupils. This distinction between procedural and subject matter knowledge is frequently made but is based largely on analytical considerations (c.f. Ryle's 1949 'knowing how' and 'knowing that'). In a complex task such as teaching, the boundaries between these knowledge bases may be less easily distinguished, and also less meaningful, as they constantly intermesh in everyday classroom practice. For instance, when teachers learn to teach a new topic area, their learning seems likely to be characterised by more complex processes than simply the accumulation of new subject matter knowledge to be mapped on to old routines. Amongst other considerations, they probably think about how the topic is to be presented, anticipate the organisational and learning difficulties that the topic might create, how it fits into existing school work, and whether the children will have any interest in it.

The Research Design

The aim of the present study is to investigate rather more openly the process by which subject matter knowledge might inform classroom practice, exploring the kind of knowledge that student teachers use and how this is integrated into their professional thoughts and actions. Eight students were studied during their final teaching practice of a PGCE (junior years) course. Five of the students had primary curriculum relevant degrees (2 in science, 1 in maths, 1 in environmental science, 1 in geography) and the others had social science degreees (2 in psychology, 1 in social science). Owing to the small sample size, a comparison of these two groups could not reveal characteristic differences. However, by selecting students with a wide range of subject backgrounds it was hoped that studies of their teaching might be more likely to illuminate the various processes by which subject matter knowledge, in interaction with other knowledge bases, influences professional practice.

The study focussed upon four particular aspects of teaching where it was presumed subject matter knowledge might have some influence on the students' teaching activity. First of all, it was expected that student teachers might have certain predispositions about teaching (educational beliefs and values, conceptions of the teaching role, expectations for their own professional practice) which might relate to subject matter studies or subject matter ideologies. These were investigated using a semi-structured interview.

Secondly, subject matter knowledge inevitably enters into student teachers' lesson planning and data was collected on this through the planning protocols of students for two lessons. The students were asked to plan their lessons out loud (see Calderhead 1981 for a discussion of the methodology), making explicit at the beginning any previous thoughts or discussions about the lesson they were planning and thereafter to think aloud as they planned the lesson. In the case of students with a curriculum relevant degree, one of the lessons was planned in this area of the curriculum, when possible.

Thirdly, it was expected that subject matter knowledge might influence classroom interaction. To assess this impact, the two planned lessons were videotaped when taught in the classroom and the student teachers viewed these immediately afterwards, providing a commentary upon their thinking during the lesson. Both planning and stimulated recall commentaries were analysed for evidence of subject matter knowledge use.

Lastly, the question of whether subject matter knowledge entered into the student teachers' assessments of pupils' work was investigated. After giving their lesson commentaries each student was asked to select 3 children from their class, one highly competent in the subject matter of the lesson, one average, and one below average, and to talk about the pupils' abilities and difficulties.

In the case of the planning and stimulated recall protocols, the students had a 'trial run' beforehand to become familiar with the procedures involved.

Data Analysis

All of the data consists of tape-recorded commentaries or protocols. These were analysed by first of all examining the nature of the students' reports and then by summarising the accounts they provided of the teaching processes in which they engaged. Particular attention was given to instances where students made reference to subject matter, or where issues were raised which were possibly relevant to our understanding of subject matter use. The commentaries of all students were then compared and contrasted to examine similarities and differences in these instances. The aim of the analysis was to reach a description and understanding of students' teaching processes and how their subject matter knowledge figured within them.

Student Teachers' Predispositions towards Teaching

In a semi-structured interview, students were asked to talk about how they viewed the aims and purposes of teaching, how they perceived their role as a teacher, their strengths and weaknesses as a teacher, the important experiences that have contributed to their teaching, the primary school curriculum and their attitudes to different areas of it, their attitudes towards the teaching

practice school, the influences and constraints upon their teaching and the satisfactions they obtain from teaching. The aim of the interview was to elicit any beliefs student teachers might have that influence their thinking about subject matter and its function in teaching processes. Inevitably some of students' talk in response to such an interview situation will include the text book ideology or staffroom folklore with which they are most familiar as well as beliefs to which they genuinely have some commitment. To minimise the former the students were asked not to feel obliged to produce answers to the questions where the questions did not seem to relate to their own beliefs and experience.

In talking about how they perceived the aims and purposes of teaching, four students mentioned both the social and academic aspects of schooling. The social aspects, in the sense of forming relationships and learning to get on with other people, were regarded as equally or more important than the learning of basic skills, and students often attributed the formation of these beliefs to their experiences in schools on teaching practices.

"Before I came here I would have said that one of the major aims was teaching children to be competent intellectually. Not necessarily having facts at their fingertips but being able to manipulate data or being able to do maths or find out information, being able to read and write. But I think more important is the social thing now... Unless you've got them happy and interacting socially well then they're not going to learn the basic intellectual skills anyway."

(Kim, psychology graduate)

Other students stressed the importance of "relating what goes on in school to the environment around them", "preparing children for life", "preparing children for secondary school" and two students suggested that ensuring children enjoy school and schoolwork were important aims.

"Mainly it's attitudes, getting children so that they can enjoy coming to school and enjoy the work they are doing."

(Mark, geography graduate)

All of the students had in mind an idea of the kind of teacher role they hoped to fulfil. The relationships they had with children figured strongly in these ideas for 5 of the students, and focussed particularly on the importance of a relaxed, friendly relationship coupled with firm control and respect from the pupils.

"I see myself as being friendly but firm with the children so that we've got a fairly relaxed atmosphere in the class and children don't feel they can't approach me... but on the other hand I like to feel I've got control of the situation and that the children will respond to me if I need them to."

(Tom, maths graduate)

A further two students stressed the importance of a caring relationship.

"I'd hopefully be a caring teacher. I'd rather be caring than just go in and not build any of those kind of relationships up with children which allow you to get to know them in and out of school."

(Julie, env. science graduate)

These two students also placed equal emphasis on the more pedagogic and managerial aspects of the teacher's role – being "well-prepared", "well-organised", "marking children's work promptly" and being "on top of everything".

Two students mentioned the need to consider the individual differences of children and of making time to talk to children individually to identify their interests and difficulties. Another mentioned the desirability of knowing children and of considering, when planning lessons, how individuals can be usefully grouped.

Although the students had an ideal teacher role in mind, most felt that their actual style of teaching was still very much in the process of development, and that they weren't altogether in control of this. One pointed out that in the classroom situation the struggle to survive tended to over-rule any consideration of ideals.

"In the actual practical situation you have more pragmatic reasons for doing things, especially on teaching practice... if you came and asked me after I'd been teaching for 2 or 3 years I might say, 'Yes I'm really striving to achieve these sort of ideals', but at the moment I'm striving to survive, basically. What I'm interested in is being able to establish control over the class and the kind of behaviour that I want. Teaching really is secondary, to be quite honest."

(Simon, social science graduate)

Two students pointed out how their supervising teacher indirectly but inevitably influenced how they taught.

"You find yourself standing in the shadow of that man (supervising teacher) and doing the same type of thing because the children are used to that, and that's the safest thing for you to do. I think there is a danger that you tend to become almost a clone of the teacher you are with on teaching practice, which is O.K. if you've got a smashing teacher."

(Mark, geography graduate)

In talking about specific difficulties they experienced or what they perceived as weaknesses in their current practice, the students almost exclusively referred to aspects of classroom management. They expressed concern about obtaining "respect" from the children, the difficulties of maintaining control, particularly in "free" situations, and knowing when to intervene in what a child is doing and when not.

"The thing I've got to build up on is being able to relax during lessons and pause and be able to do the scanning of the class and being able to feel that relaxed that you know when to leave a child alone... They don't need continuous directing and you don't need to hover all the time."

(Julie, env. science graduate)

When asked about past experiences that might have been particularly influential in their formation of ideas about primary teaching, all of the students spoke about their own education. Three mentioned their primary and secondary education as being influential, particularly the latter. Six mentioned the importance of their degree studies. The students' own education was felt to have provided them not only with a fund of knowledge, but enjoyable experiences which they felt gave them some insight into how to make education enjoyable for others.

"I think obviously my degree had an influence... That makes me want to put the importance in education as the establishment of social relations and cooperation. I think that's important."

(Simon, social science graduate)

"Last teaching practice, I used a lot of environmental studies or science work that I'd learnt from my degree. It wasn't so much doing it at that kind of level but there were just little things that I could add."

(Julie, env. science graduate)

A number of other experiences were also mentioned as having been valuable to them in their intended teaching career, and these generally related to some aspect of close human relationships.

"After I'd done my A-levels I went from school with some of the teachers and students to Iceland on an expedition, and I remember being impressed by the fact that the teachers were willing to be with us as people rather than as kids, and it was the first time I'd ever noticed teachers being people rather than teachers. I remember that as being something I was quite impressed by, and quite shocked as well that for so long they could have hidden from me that they were really people and that they had the same worries and interests as anyone else... I thought then that teachers ought not to be so distant. That was the first time I actually noticed teachers were really people. That's late on, isn't it, eighteen? But I think that may have influenced me, trying to be more friendly and more personal with the children which is something I always wanted to be because part of what I see teaching about is being with children..."

(Kim, psychology graduate)

"This is going to sound a bit crass, but I think I've come from quite a caring background where I've had a lot of support from my parents and I think that's important, because I think that's something important for children: they know someone cares about them and is looking out for what they're doing."

(Mark, geography graduate)

The last student also felt that his experience as an overseas voluntary worker had been particularly useful in understanding and establishing good relationships with children in one of his teaching practice schools which had a high proportion of ethnic minorities.

The students were asked to recall some specific problems they had encountered on teaching practice and to state how they coped with them, in particular to indicate any source of knowledge or experience that had been influential in resolving them. In response to this, the students seemed quite pragmatically oriented. Their responses were mostly to think about what "worked" on a previous teaching practice or to consider how their supervising teacher coped with similar problems. They also reported remembering not to repeat their mistakes, and 'thinking out' strategies for future use.

"On the first practice, most things seemed to go really well and it wasn't until about the third week and I made a great big blunder and I organised things really badly that I think I learned more in that lesson than I did in the rest of the three weeks... At the time you feel really awful and think that was disastrous and I'm really embarrassed about it but when you think about what you did and how you did it wrongly and the way you could have improved it I think I've learned more that way than by getting things right... Other things you've seen other teachers doing, managing children in certain ways, and you think 'that's good' and that tends to stick in my mind a lot... (Supervising teacher), for instance, the first day I was in here said "Right, Lisa. You're all ready to go, off you go." And immediately the kids were (sitting up) like this. It was better than

"Right, get yourselves ready. You're not going until you're ready." This sort of attitude I've seen in other schools. It was so effective. It was so positive all the time. Those are the sorts of things I'd like to keep in my mind."

(Tom, maths graduate)

"Always from lesson evaluations, you learn things; not to put yourself in certain situations again. Also from having seen other people teach... I can sometimes see myself doing things, knowing full well what the outcome is going to be but not having anything else to do, having no choice. Given a few years I'll be able to handle things like that and think up other solutions."

(Claire, science graduate)

In talking about the primary school curriculum, students generally regarded the curriculum as given. It was there to be taught and questions concerning its appropriateness and suitability were beyond their control and apparently, in some cases, beyond their concern.

"You can't go into a school and expect to teach the way you're going to teach. For a start, the physical layout of the school... the regime the school operates, you can't go against the way the school runs... if the school runs a programmed maths and programmed language scheme then you've got to do it, and also if the school operates a certain set of behaviour rules... it's going to fairly difficult to do something different."

(Simon, social science graduate)

When students did comment on particular areas of the curriculum it was generally to stress the importance of the area which related most closely to their own degree studies. Two social science graduates, for instance, suggested there ought to be political studies and more emphasis on life-oriented skills. A science graduate reported being "horrified" at the lack of science in primary schools. The mathematics graduate commented on the inappropriateness of fractions and decimals in the primary curriculum and suggested that other mathematical activities might be better integrated into the rest of the primary curriculum.

When asked about particular difficulties they experienced with the curriculum, the students reported a number of problems. Managerial difficulties with subjects like science. P.E. and art, and coping with the wide ability range in mathematics were repeatedly mentioned.

"I worry about those lessons (P.E. and drama) whereas I don't worry so much about lessons in a classroom where I know what I'm going to tell them. I know what they're going to do and I roughly know how they are going to behave, but in a hall it's totally different."

(Claire, science graduate)

Three students felt hampered by their own inabilities in particular subject areas.

"I feel I have no ability (in art) whatsoever. I know you don't have to be good at it to inspire other people and teach other people but if someone says to me 'I can't draw his foot.' I just don't know what to say to that... P.E. is the same... and especially with P.E. I feel I'm not exactly sure what we're hoping to achieve with the children at the end of the P.E. session."

(Christina, science graduate)

"In my own schooling, I didn't understand a lot of the things (in maths) and I still don't. I know what to do. I know what to do with the numbers but I don't understand why. I think if I understood why I'd be a lot more confident."

(Kathryn, psychology graduate)

"I'm not confident with maths. That's due to my own schooling. I don't have an overview. I feel as though I need to understand a whole area to be able to see where the kids are going. With language I can understand it well enough to know that if a kid's having certain problems I can see how to get them from one place to the next... but with maths because I don't understand it myself and I don't have an overview of what maths is or how you teach it or how you learn it or what you need to be able to do I feel very much at a loss. I can teach a lesson here and there but I don't have any image of progression in mind... I still feel as though I'm sticking to basics, like adding and subtracting, dividing and multiplying rather than any interesting explorations into maths, simply because I don't know how to explore."

(Kim, psychology graduate)

Two students reported the difficulties of trying to keep one step ahead of the children in teaching an area that was unfamiliar.

"With this project it's more local history and history based, and although it is environmental studies I'm finding it harder work because I'm actually having to go out and find a lot of information and I will have to continue to do that. Whereas if it was more of a science based one, I'd find it a lot easier to lay my hands on resources and know where to go, what to do, and what to plan."

(Julie, env. science graduate)

Five students thought they needed some personal experience of the subject matter in order to boost their confidence as well as making the planning and teaching of lessons easier.

"To be a really good teacher you've got to be enthusiastic... and you can't do it unless it's there. This is the trouble with P.E. I've never liked P.E. at school or anything, and therefore I find it very hard to convey enthusiasm. I may stand there in a track suit, but I couldn't demonstrate a head-stand to them... it makes you feel a bit of a fraud. Whereas if you have got something you can offer and be really confident in and convey your enthusiasm, then it's vastly better. I can do it with computing and with science lessons. I know what I'm talking about and they can ask me anything and I know I'm going to have the answer.... Art as well is another thing that I haven't done much of at all and I feel I have to make more of an effort towards those lessons and consequently I'm a bit more edgey about it and probably not so relaxed which all transfers to the children."

(Claire, science graduate)

"The uncertainty of how the children are going to react and how you are going to carry it through (affects confidence)... I think perhaps once you've had a good experience of something that gives you the confidence to go and carry it on."

(Tom, maths graduate)

The last student also reported that having struggled with his maths degree and having found maths difficult at university was an important experience for him, helping him empathise with the difficulties that children face in the classroom.

In talking about their current teaching practices, all of the students regarded their supervising teachers and the schools and staff generally as important and valued sources of guidance and support.

"I think this is a super school for training teachers. It's excellent. The teacher I've got is just so conscientious and so helpful towards me."

(Mark, geography graduate)

"I think this school is pretty amazing because all of the staff talk to you and seem to care about what you are doing and they don't treat you just as a student they treat you as a member of their team, and if you've got opinions they're not offended and they want you to express them, they want you to talk."

(Julie, env. science graduate)

Students spoke very highly of the professional competence and dedication of supervising teachers. They thought they learned a lot from observing and talking to teachers. One student felt that in comparison with his supervising teacher he himself fell far short of the professional competence necessary to teach well in his present school. Another reported that although experienced teachers taught well in her teaching practice school the discipline was too lax for student teachers, who as a result had difficulty coping.

"I've learnt an awful lot from him (supervising teacher)... I learn so much just by watching him."

(Christina, science graduate)

"The whole school is fairly lax in its discipline and I find that holds me back from achieving things with the children."

(Kim, psychology graduate)

In spite of viewing their supervising teachers and other staff as very supportive, students perceived a number of obstacles to their own professional development. A wide range of factors were reported which they thought might prevent them from becoming the type of teacher they really wanted to be. These included their own professional competence and personality, school policy and organisation, material provision and the intensive demands of teaching itself. One student mentioned the severe social problems of the children as a great hindrance to the whole process of education, another spoke of the disillusionment that she experienced when her own ideals met the sharply contrasting reality of the classroom.

"I have been to one school where envionmental studies was such a new thing, and also the idea of creative English work. Somebody actually said "Children just aren't creative"... I thought 'where would I get if I wanted to do a lot of this type of work'."

(Julie, env. science graduate)

"I can see myself being demoralised by the sheer hard work of it all. Because I want to achieve a lot, it means that I have to work very hard and already that's becoming a bind. There are times when you go around thinking 'Should I spend so many hours of my life just thinking about it, and all the time and working it out for so little appreciable change in the children and their lives'."

(Kim, psychology graduate)

Finally, the satisfaction that the students obtained from their work as teachers were reported to result firstly from the relationships with children and secondly from seeing pupils achieve.

"I get the biggest buzz personally from seeing children really interested in what they're doing, to see them genuinely interested so that you literally have to drag them away and they want to stop and carry on. I find it very gratifying to see children progress."

(Christina, science graduate)

"The things I do get a lot of satisfaction out of are... building personal relationships and being in the role not just of the teacher but as a guider and looking after their well being."

(Julie, env. science graduate)

Several students spoke of "the challenge" of teaching and two also mentioned the satisfaction of self-discovery which they saw as closely connected with their professional development.

"There's a feeling of self-improvement... (Learning to teach) is about you as a person as well as a teacher. It's a lot about self-discovery, which is pretty hard sometimes."

(Mark, geography graduate)

Summary of Students' Predispositions towards Teaching

Although the students vary in their views about teaching and in their own experiences in the classroom, a number of trends characterise the group as a whole. First of all, the students placed a great deal of emphasis on the social relationships in the classroom and an important aspect of the teacher's role was seen as negotiating relationships between themselves and the pupils and amongst the pupils. Establishing a "relaxed", "friendly" classroom climate came high in the students' order of priorities, and was often regarded as a pre-requisite for classroom work and children's learning. The origin of these beliefs was usually attributed to the students' experiences in schools. The students, however, were also aware of the contrast between the ideals they held for how they would like to teach and classroom reality. Although they had visions of the teachers they hoped to become, their day-to-day concern was less with realising these visions than with coping and surviving and developing teaching strategies that worked. The students were aware of many factors in the teaching environment that shaped and constrained the development of their own practice, yet their views of the teachers with whom they came into contact reflected a great deal of respect and even admiration both for their helpfulness and professional competence. As for subject matter knowledge and academic experience, this was regarded as one amongst several important pre-requisites for teaching. All students felt that their subject matter knowledge was patchy for the work of a primary school teacher. While they felt knowledgeable in some areas, they felt quite ignorant and incompetent in others. The students viewed knowledge of a subject area as helpful in several respects. Firstly, as an aid to planning: knowledge of the subject area brought with it knowledge of sources of reference, materials, facts and ideas which could aid lesson preparation. Secondly, as a source of evaluation and direction in long term planning, enabling students to decide what are worthwhile activities and how one might lead on to the next. Thirdly, as a contribution to diagnosis: an overview of an area was regarded as facilitating the identification of pupils' difficulties and how they might be remediated. Fourthly, subject

matter knowledge was viewed as providing a fund of knowledge on which to draw in response to pupil questions and unexpected classroom events, and perhaps more importantly as a boost to students' confidence in their knowing that they will be able to deal with such events when they occur. Fifthly, as a source of enthusiasm: knowledge of a subject area was thought to be accompanied by greater enthusiasm for the subject matter, leading in turn to more enthusiastic teaching and learning.

Many of these claimed advantages of subject matter knowledge, however, are not attributable to subject matter knowledge alone, and it was not always lack of academic knowledge that presented the students with difficulties, as several themselves indicated. In addition to subject matter knowledge, students had to know how to organise and present the activities in that area of the curriculum, how children might respond to them, and what expectations to hold for children's behaviour during the lesson: these were as troubling as the subject matter knowledge itself, and were possibly regarded as more difficult for them to attain.

In summary, all of the students had subject matter strengths and weaknesses, but all faced the problems of drawing upon their available knowledge to plan, organise and implement particular activities: this involved amalgamating different sources of knowledge, and translating their subject matter knowledge into more 'action-relevant' knowledge. The remaining data were analysed with the aim of shedding some light on the nature of this process.

Planning Protocols

The student teachers varied somewhat in their approach to producing planning protocols. Some had already thought about their lessons beforehand and discussed matters with their supervising teacher and began the planning session with a review of their thinking and discussion up to that point, thereafter providing a think-aloud commentary. Others provided think-aloud commentaries from their very first thoughts about the lesson, and in some cases, provided additional protocols when they had thought about their lesson again later. One student found it impossible to talk and think at the same time and therefore produced a protocol by interspersing brief periods of thinking with the tape recorder switched off with periods of recalling those thoughts with the tape recorder switched on. Despite these variations in approach, the protocols provided quite extensive data concerning the thinking that accompanied students' lesson planning. These data were analysed in terms of identifying the starting point of planning, the process of planning and the types of knowledge and resources that students drew upon during these planning processes.

The students' first statements in the planning protocols took various forms. Usually they made some mention of the topic or type of work in which the children were engaged in this particular area of the curriculum. In addition, some students started with a general idea for the lesson, others with a statement of organisational or time constraints that would determine the lesson format and some students started with a particular aim in mind.

"We are studying maps in maths at the moment, doing some practical work, especially with a view to a field course we are going on in the Peak District. We

have done some map work before. In this lesson, I want to be able to take a look at problems that arose in the previous lesson's map work session."

(Christina, maths)

"Right, tomorrow it wants to be a maths lesson and it wants to last for only about half an hour. I was thinking earlier it might be nice to do something that would tie in with the project we started on Wednesday to do with being stranded on a desert island."

(Kim, maths)

Thereafter, the process of planning generally followed a similar pattern. Students would alternate between periods of refining their ideas for the lesson, considering exactly what content would be covered and what the children would do, and periods of mentally projecting these into the real-life situation to consider how it might work, how will the children respond, and the difficulties that the real-life context might present. This in turn often led to the modification or abandoning of the previous ideas. For instance, Christina decided on doing a lesson on 6-figure grid references, but after considering the difficulties that sharing 10 maps and 10 compasses would present for a class lesson, opted to get a class lesson going on a worksheet, and then move around the 3 groups with the 6-figure reference lesson as another related concurrent activity. Her lesson planning then went on to elaborate on the nature of the worksheet and what she would do in the groups. In a lesson on measuring weight, Simon decided to start the lesson dramatically, then re-considered when he thought about the children and their possible reactions:

"I like to have something to start the lesson whereby you can grab their attention straight away. I think that's always important. A trick – something that will make them stop and say 'what's he up to? what's he doing?' A lump of polystyrene looking like concrete – something surprising. Something that I could pretend to carry – hold with two hands. No, no, might be a bit silly this. No, they might already be pretty high. Perhaps I better not encourage too much fun and games early on."

(Simon, maths)

This process of interaction between their ideas for the lesson and their knowledge of classroom reality would continue, and the details of the lesson gradually became more clearly focussed through successive interactions. This is indicated in the following protocol of Claire's science lesson, involving an experiment on testing the strength of alternatively shaped bridge-supports by increasing the weights on them until they crumple. The protocol is edited to highlight these contrasting concerns.

"The book gives me the basic ideas – which shapes to suggest the children use – circular ones, square, triangular, hexagonal – but it doesn't give instructions as to how to make the triangle, hexagonal tube shape, so that is something I am going to have to sort out for the children, because I can't just tell them to make an hexagonal pillar, they just won't be able to do it...

"They could work individually, but I think it would need too much paper and it is a bit messy so I think it best to keep them in pairs...

"Right, having looked in the book at the experiment, it's quite straightforward – needs a fair amount of explanation, but in my last science lesson I actually set up an experiment myself so they could see what it looked like and I think I will do the same again, so they can see what they are supposed to do...

"It would be a good idea to find some pictures of bridges with different shaped pillars. To show them and spark off a discussion why they think the pillars are that shape and why some are different, what the factors are that may affect the strength of bridges. I can see one or two things are going to crop up, like the boat-shaped pillars for less water-resistance. This will cause sidetracks but I am just going to have to cope and concentrate on getting them to think about the shape of the pillars and nothing else...

"I will cut out the paper to the right sizes, strips... so, given the strips, it's easy enough to make a circular tube. Square – they will have to divide it by 4 and fold it into 4 equal parts – that might be a bit difficult bearing in mind the problems they had last week in art. I don't think they will be able to cope with 4 equal parts for a square. I will have to give them the measurements probably. I shouldn't really, but it's a question of time in the science lesson, although the measuring is valuable. I have also got to get through the experiment. Some of them will be O.K. and will be able to manage it alright, others will need help. I wonder if it is worth having a banda with strips marked out and the measurements on so that they know how to fold it. I think, I'm not sure. Or else I could do it on the whiteboard for them to look at. Trouble is with the whiteboard it is always in a corner of the room and they have to keep getting up to go and look at it. Gets a bit chaotic... I don't want to give it on a plate, if they are capable of doing it themselves. So I will get a banda done for those that will have problems, but be a bit selective in who I give it to...

"Right, so they know how to fold it, now they have to stick it. This is a problem. I tried it myself with glue and sellotape. They both worked but sellotape is a lot easier. But we only have a couple of reels and they would be bouncing all over the place trying to cut sellotape and it is expensive. Trouble with the glue is that it gets very messy, but at least they can have a pot of glue each with not much hassle. I think I will try it with the glue, but have the sellotape around in case some of them get into too much of a mess. But at the start if I really emphasise the correct way to glue, the amount of glue to use, because they are only going to have a thin strip 1 cm. wide to glue. So I will have to make sure they don't use too much. Might be worth having some paper clips to hold it just in case.

"Results in a table, I think. It will help them remember the different shapes... Last time, all of them were confused between a graph and a table. They seem to think a table is something to be done on squared paper. I don't know where they have got that from, but it needs putting right. So, make sure they all know what a table is. Draw it perhaps on the whiteboard.

"It would be nice with these sort of lessons if I could bring them all together at the end to discuss what they all found out, to compare each other's results – but it is all so difficult in the open plan classroom when they are mixed in with the art people as well. To gather them all together at the end is very difficult. I think perhaps I am better off trying to get around each pair towards the end of the lesson and just talking through their results with them, rather than trying to grab them from different areas of the classroom.

"I could provide them with two types of paper – sugar paper and thinner paper – and see what difference that makes. They take so long doing anything like this so that I think it best to limit it to the one sort of paper for the 4 different shapes to start with. I don't want it to get too complicated in the explanation. See how it goes timewise, and if they are getting through it very quickly then suggest

alternatives such as different types of paper, different diameters, plus their own suggestions. I must stick to the four shapes at first.

"I had better have a word about the actual measuring. Although I have given them the distances, I have noticed that a lot of them still don't use a ruler correctly. Some of them use the chewing end for the point marked nought. I had better have a word with them about that..."

Throughout the lesson, Claire's thinking about the content of the lesson interacted with her knowledge of the pupils (the time they take to do things, their knowledge of shape, the difficulties they have with measuring), the classroom constraints (time, the positioning of the whiteboard, its open plan structure), and her previous classroom experiences (demonstrating experiments, the value of report back sessions). In consequence, the nature of the lesson – what she and the pupils would be doing and what they would hope to achieve – became gradually more detailed and explicit. At several points in the planning of the lesson, the key features would be summarised, these summaries becoming gradually more refined further in the protocol, and at the end:

"So, start with the question-answer session on different pier shapes, why, get some pictures, which do they think will be the strongest sort, their predictions, why, what else do they think might affect the strength of a pillar, then I explain what they have got to do, show them my little set-up, how can they make it fair, what must they be sure to do, put weights in the centre, make sure they use the same sort of paper... So all that I have to do when I get to school is to do the banda sheet with the measurements and I have got to ready cut the paper and the cardboard square. I think that is it."

All of the students' protocols indicated a similar process of planning, involving the gradual elaboration of ideas for a lesson, in interaction with various aspects of their knowledge of classroom reality. Many of the problems or concerns which were thought through were of a managerial or organisational nature – how the class ought to be grouped, how to avoid noise and bustle, how to cope with differing abilities or the behaviour problems of particular children – though students also thought about how to explain concepts and activities so that they might appeal to children's interests and link in with prior knowledge.

"Now, how shall I have them working? If I have them working individually... they like working on their own, they don't do it a great deal. It's a good idea to get some balance between pair-work, group work and individual work and so on. Yes, I think I'll have them working individually... Quite often instead of having them in groups I arrange the desks in a horseshoe shape so that they all sit around it and I can sit in the middle and talk to them. I think that's what I'll do. Try and make it a little less spread out so that I can have a bit more control over them."

(Kim, maths)

"If each workcard had 5/6 different items on it and they had to decide themselves which is heaviest and which is lightest and write them down in order in their books – there's not a lot of work there, is there? Then they could – they were doing graphs in the first half of this term – perhaps they could graph their estimates and then perhaps measure the weights and compare the results between their estimates of weights and the measured weight to see if first of all they got them in the right order and how close they came to actually estimating weight."

(Simon, maths)

Consequently, the planning process generally resulted in some fairly detailed thoughts about what teacher and pupils will do, how long things will take, the materials to be used, how the class will be organised, possible problems that might arise, and often how the lesson fits into past and future work, and these were often summed up, sometimes repeatedly during the protocol and usually in particular detail towards the end.

Whilst planning, and particularly towards the end of the planning protocols, the students frequently paused to take notes. These were in addition to completing a more formal college lesson plan, and were sometimes used as an aide memoire immediately before and during the lesson. The form of the written notes varied but often included the instructions that they would give to the children, how the children will be grouped and questions which seemed particularly appropriate. Some also noted down specific lesson aims, concepts and skills to be taught, the expected time that each part of the lesson might take, a list of follow-up activities if the children finish the work earlier than expected, and a list of materials that will have to be made ready.

The ideas which students drew upon in their planning protocols were quite frequently attributed to the supervising teacher, a past teaching experience or the observation of what other teachers do, or a combination of these. For instance, in planning a creative writing lesson based on the experience of tasting a lemon, Simon acknowledges all 3 sources early in the protocol.

"One of the things I want to encourage in language this half term – this is at the suggestion of the class teacher – is more descriptive writing...

"What I think we'll do is something that I've done before, with some creative writing once about a candle – whereby I got the class to engage in the experience – to look at the candle for a minute and just experience it and then afterwards to jot down any images, ideas, anything the experience caused them to think – any feelings it reminded them of. I think we could do the same thing with the lemon...

"When I'm starting a lesson off, I like to have something to attract their attention... I could do a mime. I once saw a teacher when I was on a preliminary visit – she did a mime of lighting a birthday cake – putting the candles in the birthday cake, lighting it up and blowing it out, as an introduction to this story about making a wish."

The exact source of lesson ideas is not always clear from the protocols, but in the 16 planning protocols, 6 make reference to the supervising teacher as a source of ideas and suggestions. 3 take ideas from a past teaching experience, and 2 refer to ideas taken from a previously observed lesson. In 3 cases, the ideas for lessons are obtained from books. On some occasions, students have devised lessons around their own materials or deliberately avoided textbook exercises because they don't suit the students' purposes at the time. In 8 cases, the lesson is part of an ongoing theme or project that the class are working on and the extent to which students are involved in their long-term planning seemed to vary considerably from school to school and project to project. Overall, however, the source of ideas for planning, where these are made explicit, concern school related activities. Only one student explicitly linked a college experience to her lesson planning:

"At college we have talked about draft writing, the children actually write several drafts, shape it, get it the way they want it and actually get it written up into best. Watching the way they have been working, they often write it straight down and read it through. The structure is there but very weak. If they get the chance to do some draft writing they can actually see how it is going and shift bits around and get it to the way they want it. Their spellings tend to be quite poor and if they are doing their draft writing I can ask them to check the spelling and punctuation..."

(Julie, project)

Another student referred to his own educational ideology as a source of ideas concerning the organisation of schoolwork and this did seem to enter into a lot of his planning of a maths lesson measuring area, though it was an ideology that was well supported in his particular teaching practice school:

"I don't want to act in a formal type of way, telling the children that they are going to measure such and such by marking cm^2 on it. I don't want to do any of that. I want to give them a problem, get them to work it out, possibly on their own or in pairs. I think in this I want them to work in pairs because it helps your own thought processes. Then to bring them together to talk about it and see the ways they did it. We have got quite good discussion rules, although some will interrupt. On the whole they do listen well and I think my role should be guiding, acting as a chairperson, which is actually one of the most difficult roles I find, especially when you know they are way off the mark and you don't want to discourage them. They may not be way off the mark, but looking at it from a different way from you."

(Mark, maths)

At no time did students refer to their own store of subject matter knowledge or to ideas or insights that might have originated from their particular degree studies. At the beginning of one protocol, a student, who had previously reported that his degree studies had made a valuable contribution to his competence in teaching, did comment:

"If I didn't have a geography degree would I still be going ahead with this particular lesson? The answer to that is yes. I would have done geography A-level and the amount of knowledge I am going to use to teach these children, a degree isn't necessary. In fact, I did a lot of mapwork but a lot of it would be over their heads. It gives me the confidence, I think, to know that I am on home ground."

(Mark, project)

Given the views the students had about subject matter knowledge and the value of their degree studies, it is a little surprising that no reference was made to it in the planning protocols. Obviously, students' subject matter knowledge could be influencing their lesson planning indirectly, providing the unarticulated overview or rationale for selecting particular activities or helping to clarify students' thinking about the purposes of certain activities and how they might lead on to the development of particular areas of knowledge and skill. Certainly, there are several planning protocols which, throughout, reveal quite extensive thinking about the context of the lesson in a larger scheme of work, its relationship to children's knowledge and competence, and considerable foresight and empathy with the difficulties of the children. However, these do not appear to coincide with the students' higher education studies.

For instance, Julie, who has a degree in environmental science, expresses considerable awareness of alternative ways of presenting her lesson on 2-D shape and anticipates the difficulties the children might have. She also indicates how the lesson will develop into future work on 3-D shape, how it links with past work on symmetry and concurrent work on tiling, and how art, maths and practical activities might inter-relate. This awareness also extends to her planning of project work where she uses a series of photographs bought from a junk shop to link into a local history project, following work on census data and the occupations people had at the turn of the century, planning some writing around these, carefully assessing the children's developing abilities to conceptualise life in past times.

Similarly, Christina, with a combined genetics and zoology degree, expresses quite a detailed overview of a series of craft, design and technology lessons: the problems of linking the design to the materials available, the process of design and construction, the problems of wheel movement and wheel grip that the pupils will encounter in the model building and how they might respond to them.

Kim, a psychology graduate, who claimed not to have an overview of mathematics, plans a lesson on co-ordinates with clear intentions of developing work on scale and tie-ing these in with future work on maps and past creative writing, and also expresses a keen awareness of the competencies and difficulties of the group of 14 children she teaches.

Mark, a geography graduate, has a series of lessons on area in mind, carefully sequenced from potato printing to measuring the area of the classroom, oriented to the children's discovery and understanding of the concept of area and how it is measured and with an awareness of the alternative strategies that children might adopt in the given tasks and the abilities the children have exhibited in the past.

While it seems difficult to explain these trends in terms of the students' higher education studies, it does appear to relate to the students' own reports of being involved with supervising teachers in a co-operative exercise of long-term planning, and in the exchange of ideas. Mark and Julie, and to a lesser extent Kim and Christina, reported frequently engaging in conferences with their supervising teachers about how they would plan their teaching and also evaluating how past lessons had gone. It could tentatively be suggested that student teachers' awareness of the curriculum context of their lessons, their demands upon children and the difficulties children might have in meeting these demands, owes more to the professional experiences student teachers have in schools with other teachers than to their previous degree studies. Furthermore, one could speculate that the harnessing of those degree studies to improve the quality of work done in schools might depend crucially upon the experiences offered to students in schools, and the opportunities they are awarded to translate this knowledge into more 'action-relevant' or 'practical knowledge' in the context of both long and short-term planning.

Stimulated Recall Protocols

Although the students were asked to recall the thoughts that accompanied their teaching as they watched the videos of their lessons, their protocols frequently

also included comments and evaluations upon their teaching, and descriptions and explanations of ongoing events.

The students' evaluative comments often referred to the effectiveness of their explanations or instructions, particularly at the beginning of the lesson, and several focussed on classroom management. Some evaluations referred to parts of the planned lesson that had been accidentally omitted. Occasionally the video itself would offer students a perspective on their teaching which contrasted with their own perceptions at the time: this 'realisation' would often be accompanied by a change in their personal evaluation. A few evaluative comments focussed upon the pupils, particularly their behaviour, rather than the students' own teaching approach. Evaluations were sometimes accompanied by a mental note on how the lesson could have been improved or how future work might be integrated with the current lesson.

"I don't think I explained this very clearly. I think I was very woolly with it. I should have used the board and write down the problem again in stages."

(Tom, maths)

"Looking at it now, I realised that I was going for the kids who put their hands up the most. Particularly Angela in the corner."

(Claire, science)

"They seemed so interested in the photographs. I thought why don't we get them to bring in their own photographs. I thought as we had some old-fashioned photos of children at different ages, why not ask them to bring in photos of them at different ages."

(Julie, project)

The students' descriptions and explanations generally elaborated on particular events, interpreting the ongoing interactions and providing information about pupils, past activities or the students' intentions, which made classroom actions more comprehensible.

"He's a lot better than he used to be when I first was working with this group. Martin was always on the move. He never sat down for more than 2 minutes. He used to throw tantrums. He used to throw himself off his chair and roll around on the floor and shout, and go off and sulk and cry. At first, I used to really pamper to him. If I saw any signs of him being frustrated I used to whizz to him straight away to try and calm him down before anything happened."

(Kim, language)

When students recalled their thought processes, these referred most often to managerial (control) and organisational aspects of their work. The students' main concerns appeared to be with implementing their planned lesson, negotiating transitions from one activity or phase of the lesson to another, and coping with the unexpected events and unforeseen difficulties that always arose.

"I was thinking how the lesson was unfolding, but I was also thinking what was on the map – I was thinking along with them."

(Mark, project)

"At this point I suddenly realised there was one child making the shapes and the other just sitting there, so I had to go round and tell them all to do two each."

(Claire, science)

"I was conscious how quick some children were and how slow some were and I had to quickly think – which I hadn't thought of before the lesson – what can I give those who are forging ahead. I was trying to work out as I was going round how to settle them until the others caught up. I gave them something to work on from yesterday – while they were working."

(Julie, maths)

Far fewer recalled thoughts related to instruction or children's learning, though these occurred more frequently when the student was responsible for teaching a small group (the class teacher usually taking the others) rather than the whole class.

"At that point I was trying to make the links between the previous lesson – the shapes we had been working on – and what I was going to do today."

(Julie, maths)

"I was trying to encourage their ideas. Sometimes I feel you really need to encourage them and let them follow it through and develop it. Even though perhaps I could see something that didn't quite fit in I still tried to encourage it – let them follow it through."

(Kathryn, language)

"I was trying to explain here thinking about how the word sounds when you say it compared to how it would look on paper."

(Tom, language)

Occasionally, both managerial and instructional concerns meshed in the students' thinking.

"There, I was trying to explain things and watch them get settled, so I had my mind going in two directions – one, thinking about when are they going to settle down, and two, trying to explain.

(Julie, maths)

Several students' recalled thoughts focussed on the interactional processes within groups in the class: their concern was neither management nor instruction directly, but facilitating certain group interactions that might enable learning and discovery to take place.

"We were talking about how to get everyone involved again, because Alex was still looking completely bored with the topic. I wanted them to envisage their role in the group in some way. I wondered how much they had thought about their role themselves... I wanted to make sure everyone knew their roles, felt part of it and had something to do."

(Christina, craft)

Recalled thoughts frequently focussed on misjudgements, when the students' planned actions were found to be inappropriate, or on dilemmas that emerged during the lesson.

"I was talking about scale again and I did seriously wonder whether to have a talk on the blackboard about scale and how to convert and use the scale. But because of time and because I thought that if I could prepare I could do it better, I decided not to. I would like to leave it to a later time when I could get some thing properly prepared on it."

(Christina, maths)

"As soon as he started reading I thought it was a disaster. I wish I hadn't picked him because it was hopeless. When I was listening to him read, I was trying to decide whether to take over reading myself or to let him stumble through it. I knew they couldn't really hear. When I was listening I was trying to decide what to do."

(Claire, language)

Some recalled thoughts and explanations also reflected the students' own feelings of insecurity and doubts about their own competence.

"I was a bit worried about explaining these different properties because I'm not entirely sure myself. I've never done a lot on shape."

(Kathryn, maths)

" I think at this stage I wasn't quite sure what I was doing... I lost the gist of what I wanted to say."

(Simon, language)

When the lesson appeared to be going smoothly, students often did not recall their thoughts, or expressed that it was difficult to make any comment.

"There doesn't seem to be much for me to say this time. It wasn't such a panic as yesterday, so there were less things happening. I felt so much like I knew what I was doing and they were responding much more in the way I wanted them to, that there wasn't any changes of plan or terrible things to deal with or anything like that. It just seemed much more coherent today."

(Kim, maths)

Given the students' primary concerns with implementing the lesson plan and coping with managerial problems and unexpected events, there was little scope for subject matter knowledge to enter into their classroom thinking. However, there were some occasions when students' knowledge of a subject area, or lack of knowledge, did enter their considerations of how to cope with particular problems. For instance, Tom, early in a group maths lesson on division by subtraction, realised that several of the children had difficulty completing a worksheet he had set them because of their confusions about place value.

"I think she was getting confused with hundred times a number and twenty times a number. She was saying that ten times a number, perhaps 10×48 is 480, then 4800 is 20×8. So it wasn't actually division she was confusing, it was multiplication and place value again."

He then moved round the group, giving some instruction on place value to those who had this difficulty.

In contrast, Kathryn, teaching a lesson on shape to the whole class divided into 3 groups with different activities, encounters several problems. First of all, concerning the use of a protractor:

"I got really confused here with these protractors. I never looked at them before and how to use them. And when I drew the net last night I used 60° angles, and they were saying it was 120°, and later on I realised why and I got really mixed up."

"Here again I was trying to explain it and I couldn't. He was trying to draw a hexagon and I'd drawn it the night before but... I started to panic and if you could see his face you'd be able to see what a puzzled expression he's got."

Later, she encounters a further problem when a child who is completing a table on the number of sides, vertices and edges of various 3-D shapes queries how many sides a cylinder has, and is then even more puzzled about the number of sides a sphere might have. Kathryn, however, is equally puzzled and eventually responds to the situation by asking the child to leave those parts of the table blank until she has asked the class teacher about it. In the stimulated recall protocol, she comments:

"If I'd known myself, I think I would have been able to guide him, put him on the right track and leave him to try and work it out for himself. But I didn't know, so I didn't know how I could help him, because I came really unstuck at that stage."

In these cases, Tom's more thorough knowledge of the subject area might have enabled him to cope with the difficulties and adapt his lesson. Whereas Kathryn, who at several points in the research acknowledged her own inability and lack of understanding of maths, has to survive the situation and discover the appropriate knowledge later.

The possession of subject matter knowledge alone, however, obviously did not strongly influence the on-going thought and action of the student teachers in the classroom. Comparing students' protocols, such factors as the size of the group they were teaching and the role they attempted to fulfil seem the most obvious factors influencing the kind of thinking that students engaged in. Students' thinking about diagnosing pupil difficulties and concern with explanation was more common when students were responsible for teaching only a small group, whereas managerial concerns predominated when teaching the whole class. Some lessons also appeared to be designed for the student to play a largely managerial role, irrespective of the number of children being taught. Claire's science lesson to a group of 10 pupils, for instance, was tightly structured around a science experiment, and perhaps in consequence most of her reported thoughts focus on timing, control and whether the pupils are following instructions: her concern is very much with managing the activity and seeing it through to completion. Other lessons appear to be designed for the student to play a more instructional role, where it is intended that the student will spend fairly large amounts of time in diagnosis and instruction, as in Tom's maths lesson. On other occasions, some students appear to be playing a group facilitator role, their reported classroom thinking focusses on promoting group interaction and problem-solving and suggests that they sometimes restrain themselves from becoming more didactic.

While in some lessons, reasonably extensive knowledge of the subject matter, together with a knowledge of how it relates to classroom activities and pupil difficulties is needed in order to conduct the lesson appropriately, in others it is far less likely to be used. Interestingly, it is in the evaluations of their lessons that students most often appear to be integrating their knowledge of subject matter, pupils and classroom activities – deciding on how their activities might be more appropriately designed or how other lessons need to be brought in or linked to current ones.

Pupil Assessments

At the end of each stimulated recall protocol, the students were asked to select one able, one average, and one less able pupil and to talk about their abilities and difficulties in the subject area just taught. Most of the comments made about pupils focussed upon their general approach to class work ("confident", "usually gets down to work", "needs a lot of reassurance", "the first thing that comes into her head she wants to write down"). Comments on general or particular competencies were also quite common – "very bright", "has difficulties with his tables", "uses her words quite descriptively". Some students also mentioned the pupils' presentation of work ("neat", "well-presented", "well-spaced"). Social features, particularly concerning how pupils functioned in a group, were also included ("he was a bit overpowered by Justin who is the dominant one in the group", "if he has a strong idea of his own he doesn't mind it being overuled by the others", "doesn't always contribute a lot, but listens to other people and tries to comment on it").

Some students found the task of reporting on the pupils' abilities difficult, and the commentaries varied considerably in their length and comprehensiveness. Some gave the impression of scarcely knowing the pupils or at least having great difficulty articulating this knowledge, whereas others gave the impression of having considerable knowledge as well as empathy and perceptiveness.

Jo – "She's quite slow at everything, but that's more shyness than anything else. She's reluctant to say anything in case she makes a fool of herself."

(Kim, language)

Mathew – "I think he is quite bright and does get on. He seems quite competent in what he is doing, although today he didn't seem to be coping so well with getting the edges drawn accurately. Quite often when you are giving him work he gets into it and gets bored and starts talking to the others on his table who are more behind anyway. When you go up to him and tell him to stop talking you realise that he has done that bit of work you have given him. I tend to check if he has spelling mistakes – and he hasn't. His writing is O.K. and it is neat. He knows what he is talking about. During that lesson I didn't think I was giving him enough problems. I kept thinking at the beginning that I wasn't because it was all preparation work – the next stage on, they will see the results. They were working really well and enjoying it. He was much more absorbed then. He was actually doing something and creating something of his own work and he wasn't having me to tell how to do something. He was able to get on on his own."

(Julie, maths)

Justin – "was having the most difficulty in the lesson. He was the one messing about with the gold chain. He is ever so willing, but sometimes when he asks a question you realise that he doesn't have much background at all in what you are trying to do. I was taken by surprise that he isn't a very good reader and he couldn't read some of the words on the map. There was 'surfaced path' and I said "what does this black line represent?" and I was surprised when he couldn't read it. He does have difficulty understanding. He rushes things. If he finds the scale is 1:5000 he will write it down quickly but he doesn't really think about it. I think he feels conscious that he is not very good and likes to get his worksheet filled in no matter what gets filled in. On the scale, I explained it through with him and when we arrived at the answer after I had explained it

several times, he said, "Right, that's the answer" and wrote it down quickly without paying attention to what had gone before. He just wanted to get the answer so he could write it down."

(Christina, maths)

Based on their reported assessments, it would seem that the students differ in the features of the pupils they take note of, and in the detail of their perceptions.

Given the few detailed, diagnostic subject-related assessments that were made, it is not surprising that no relation could be found between subject matter expertise and students' assessments. However, students' assessments did again seem to relate to some extent to the type of teaching role the student was attempting to fulfil, and the opportunities this role afforded for the observation and assessment of pupils. For instance, in Tom's maths lesson with a small group where he spends a large proportion of time in individual instruction, his assessments of the pupils include some quite specific competencies (e.g. "she wants it down on paper and doesn't give herself time to play around with the numbers and think how many to take away each time", "she seems to realise that if you do 10 times a number and then you do 20 times a number the answer you got multiplying by 10 is just half the size – a lot of the others don't realise that", "was subtracting starting from the left-hand side"). In the case of Claire's science lesson, a tightly structured activity in which she plays a managerial role, supervising the pupil's experiments, she commented mostly on the children's behaviour and attitudes (e.g. "quicker", "dashing to get there", "fairly capable", "managed to do it", "tended to play around and didn't start the write-up"). In Christina's craft lesson, where she attempted to fulfil a group-facilitator role, her assessments again reflect her concerns during the lesson ("patient", "fair", "contributes very little in the group", "when it comes to taking the initiative herself she is very poor", "likes to have his ideas carried out", "doesn't push himself enough").

Students' reported assessments of their pupils seem, therefore, to relate quite closely to the type of teaching and classroom organisation in which they are involved.

Discussion

The aim of this research was to explore the process by which subject matter knowledge might inform the classroom practice of student teachers. The research investigated students' own beliefs, their reported thoughts during planning and teaching and their post-lesson assessments of the pupils. It was found that although students themselves value a fund of high-level subject matter knowledge, both their own accounts of their teaching and their planning protocols suggested that their thinking about teaching was very much based upon their own practical experience in the classroom and their observation of, and discussions with, other teachers. The quality of this experience clearly varied amongst the students. Some reported being involved in quite extensive collaborative planning activities (both long and short-term) with experienced teachers, and in frequent professional discussions concerning the integration of classroom activities, alternative teaching approaches, and evaluations of past lessons. Such reported experiences seemed to relate more closely to students'

planning considerations of subject matter and how it was to be presented than did students' own educational background. In teaching, students' reported thoughts revealed concerns with both implementing the planned lesson and managing the class or group. The students appeared to adopt different roles in the classroom (managerial, instructional, group facilitator) and these might partly have been determined by the number of pupils they were assigned and the normal working arrangements in the school. Different roles offered different opportunities for the students to work with the pupils and these were associated with different types of post-lesson assessments which the students made.

These findings emphasise a number of issues concerning the nature of practical knowledge (why is practice apparently built upon practice? need it be? when and how, if at all, do the more academically and theoretically-oriented college studies influence students' practice?) and concerning how we research teachers' practical knowledge (is it appropriate to assume that subject matter knowledge influences practice through conscious processing? are there more implicit or tacit processes operating? could these be researched?).

The research also raises issues of professional concern. The experiences that students are offered in schools seem to be potentially powerful formative influences on their professional development. At present, there is little comparative data on how students' time on teaching practices is spent, on the value of alternative school experiences, or on the ways in which the student, tutor or school might facilitate professional learning processes. From this research, we might reasonably speculate that some schools are offering students very much more valuable experiences than others, providing opportunities for students to develop their practical knowlege and possibly translate parts of their own subject matter expertise into knowledge for action in the classroom. Given the current emphasis on teaching practice in pre-service education, the nature of these experiences and the processes in which student teachers engage in this period of professional growth are topics requiring urgent exploration.

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